

## Preliminary Evaluation on Vegetative of Rambutan (*Nephelium lappaceum*) in Sandy Tin-tailing Soil

Khairol, I.<sup>1\*</sup>, Fadzilahimi, I.<sup>2</sup>, Nordin, M. A.<sup>2</sup>, Muhammad Akmal, M. S.<sup>3</sup> & Nor Hadijah. A.<sup>2</sup>

<sup>1</sup>Technology Transfer and Entrepreneur Development Centre, MARDI Klang, Jalan Kebun, Batu 7 Kampung, 41000 Klang, Selangor, Malaysia. <sup>2</sup>Director General Office, MARDI Klang, Jalan Kebun, Batu 7 Kampung, 41000 Klang, Selangor, Malaysia.

<sup>3</sup>Director General Office, MARDI Kundang, Jalan Kuang, Kampung Baru Kundang, 48020 Rawang, Selangor, Malaysia.  
Corresponding Author (Khairol, I.) - Email: khairol@mardi.gov.my\*



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### ABSTRACT

The study was initiated to evaluate the early performance of rambutan (*Nephelium lappaceum*) vegetative planted on marginal sandy tin-tailing soil. The experiment was carried out for one year in a plot of 4-year-old rambutan cultivar at MARDI Kundang, Rawang, Selangor, Malaysia. Varieties of *Mutiara Merah* and *Mutiara Wangi* were used. Data from the plants as a measurement of vegetative growth was recorded. *Mutiara Merah* proved that it can be well-grown and cultivated on sandy tin-tailing soil. The plant height of *Mutiara Merah* indicated the highest significant reading. The parameter of canopy width showed the same variety contributed to the highest record. Nevertheless, *Mutiara Merah* contributed to the highest significant reading on stem diameter and perimeter respectively. Chlorophyll content in leaves of the plant of the same variety recorded the highest SPAD reading. Further field evaluations are needed to determine the relationship of fertilizer level with the different varieties in inducing the growth and yield of rambutan planted in marginal soil.

**Keywords:** Rambutan; Preliminary study; *Mutiara Merah*; *Mutiara Wangi*; Tin-tailing; Growth.

### 1. Introduction

The rambutan (*Nephelium lappaceum*), which belongs to the *Sapindaceae* family, is an exotic fruit tree native to Malaysia and Indonesia (Tindall, 1994). Thailand and Malaysia are the leading fresh rambutan exporters, but Thailand also exports a significant volume of canned rambutan to Asian and European nations (Karunakaran et al., 2016). Production of rambutan is increasing in Indonesia, Malaysia, Australia, the Philippines, and Hawaii (Karunakaran et al., 2016).

Rambutan is grown in Malaysia along the west and east coastlines in states such as Perak, Kedah, Johor, Pahang, and Terengganu. Rambutan is a popular local fruit and a related to the Chinese lychee. It gets its name from its hairy exterior. The yellow or red rambutan is high in vitamin C and vital minerals. The transparent flesh is delicate, sweet, and delicious. The rambutan is a pleasant delight in Malaysia's hot, humid weather. It is an evergreen tree that grows to a height of 15-24 meters (49–79 ft.).

Rambutans like warm tropical conditions with temperatures ranging from 22 to 30 degrees Celsius and are sensitive to temperatures below 10 degrees Celsius. It is grown commercially within 12-15 degrees of the equator. The trees thrive at heights of up to 500 m (1,600 ft.) above sea level and thrive in deep soil, clay loam, or sandy loam rich in organic content.

Growing methods for rambutan cropping have not been well studied under local conditions; however, the selection of certificated vegetative propagated planting material, irrigation facilities, the proper pruning method, and adequate harvest and post-harvest activities will determine the success of a rambutan orchard (Vanderlinden et al., 2004). Understanding tree phenology is critical for interpreting leaf nutrient status and its relevance to tree production, especially if yield and tree nutrient status are linked (Diczbalis, 2002). The research was started in order to assess the early performance of rambutan vegetative plants on marginal sandy tin-tailing soil.

## 2. Methodology

### 2.1. Experimental site

The experiment was carried out for one year in a plot of 4 years old rambutan cultivars at MARDI Kundang, Rawang, Selangor, Malaysia. The site was located at 3.2719° latitude N and 101.5144° longitude E. The daily temperature during the experiment was in the range of 30–40°C. The research station received an annual average rainfall of 600 mm on 30 rainy days distributed from September to November. The soil was sandy tin-tailing with low pH and low availability of Nitrogen (N), Phosphorus (P), and Potassium (K).

### 2.2. Planting materials

Varieties of *rambutan Mutiara Merah* and *Mutiara Wangi* at age of 4 years old were used in a fully randomized design horizontally on raised plots at a spacing of 10.0 m between plants and 10.0 m between rows triangularly.

### 2.3. Data of growth characters

Data from the plants as a measurement of vegetative growth was recorded. The parameter of stem diameter and perimeter was collected at the height of 0.5 meters from the ground using a calliper and measuring tape. The stems height was measured from the ground to the tip of stem at the lowest branches by using a steel ruler. The chlorophyll content of the leaves was measured by using a portable chlorophyll meter with measurement unit of Soil Plant Analysis Development (SPAD) reading on three leaf samples taken from each plant. The plant height was measured from the ground to the tip of the plants by using a steel ruler. The plant canopy was measured by the diameter distance between the end of two sides of the plant canopy (left and right) by using a measuring tape.

### 2.4. Experimental design and data analysis

The experimental design was a Complete Randomized Design. Analysis of t-tests was carried out to detect significant differences between the parameters. The means of the measured variables were compared by using the appropriate procedure of Statistically Analysis System (SAS) at the Duncan test ( $P < 0.05$ ).

## 3. Results and Discussions

### 3.1. T-test analysis of parameters

**Table 1.** T-test analysis of rambutan cultivation on sandy tin-tailing soil at different parameters

Source of variance	Parameters					Chlorophyll content (SPAD reading)
	Plants height (m)	Width of canopy (m)	Stem diameter (cm)	Stem perimeter (cm)	Stem Height (m)	
<b>Grand mean</b>	3.39	3.75	8.30	27.70	78.00	60.81
<b>t value</b>	0.80	1.59	0.35	0.15	0.91	12.73*

Mean with \* is significant at 0.05

Table 1 shows the results of the t-test analysis of the gathered parameters. The chlorophyll content of rambutan leaves was significantly affected. The plant's height, canopy breadth, stem diameter, stem perimeter, and stem height, on the other hand, were unaffected. It is possible to conclude that planting rambutan on marginal soil helped the plants develop successfully.

### 3.2. Evaluation of rambutan varieties on plant height

The plant height was assessed in order to justify the impacts of cultivation on marginal tin-tailing soil (Table 2). *Mutiara Merah* has the greatest significant reading, with an average of 3.5 metres, while *Mutiara Wangi* has the lowest plant height characteristics, with an average of 3.3 meters. When grown on tin-tailing soil, the *Mutiara Merah* cultivar displayed dominating development. Rambutan is acclimated to warm tropical climates and is commercially farmed within 12-15 degrees of the equator; otherwise, the tree may grow up to 700 meters above sea level (Karunakaran et al., 2016). The diversity of rambutan is relatively high, to increase the validity of the diversity, it is necessary to know its morphological and genetic characteristics. Plant species are often unique in terms of growth, habitat, and reproduction (Putri et al., 2022)

**Table 2.** Plant height of *Mutiara Merah* and *Mutiara Wangi* cultivated on sandy tin-tailing soil

Varieties/ Plant Number	<i>Mutiara Merah</i> (m)	<i>Mutiara Wangi</i> (m)
Plant 1	3.3	3.1
Plant 2	3.2	3.7
Plant 3	3.7	3.3
Plant 4	3.8	3.3
Plant 5	3.3	3.2
Mean	3.5	3.3

### 3.3. Growth parameter of rambutan varieties on stem height

The rambutan plant's stem height was measured, as indicated in Table 3. *Mutiara Wangi* has the greatest average stem height significant reading with 81.2 cm, whereas *Mutiara Merah* has the lowest influence on stem height with 74.8 cm.

**Table 3.** Stem height of *Mutiara Merah* and *Mutiara Wangi* cultivated on sandy tin-tailing soil

Varieties/ Plant Number	<i>Mutiara Merah</i> (cm)	<i>Mutiara Wangi</i> (cm)
Plant 1	41.0	45.0
Plant 2	74.0	88.0
Plant 3	100.0	89.0
Plant 4	97.0	93.0
Plant 5	62.0	91.0
Mean	74.8	81.2

Over tin-tailing sandy soil, the *Mutiara Wangi* cultivar demonstrated dominating stem height. Rambutan cultivars observed were varied in some morphological characters, i.e. leaflet shape, number of leaflets per leaf, rachis length, length of petiole, length of leaflet, leaflet width, and leaflet apex shape (Windarsih, 2022). Well-drained sandy loam to clay loam soils rich in organic matter is ideal for maximum development and production (Karunakaran et al., 2016).

### 3.4. Evaluation of rambutan varieties on width of canopy

Table 4 shows that the *Mutiara Merah* variety supplied the most significant reading with an average of 4.0 meters, whereas the *Mutiara Wangi* type contributed much less with an average of 3.5 meters. According to the parameters gathered, rambutan cultivation in sandy soil was well-grown with proper cultural practices management.

When shoot temperatures were standardised, plant growth and development were extremely sensitive to root temperature (Diczbalis & Menzel, 1998). The leaflet length, leaflet width and petiole length could be used as specific characters to differ from other cultivars. Although several leaves morphological characters could be used to distinguish some cultivars from other, there was a possibility those characters also could be found on other cultivars (Windarsih, 2022).

**Table 4.** Canopy width of *Mutiara Merah* and *Mutiara Wangi* cultivated on sandy tin-tailing soil

Varieties/ Plant Number	<i>Mutiara Merah</i> (m)	<i>Mutiara Wangi</i> (m)
Plant 1	4.1	3.7
Plant 2	3.5	4.2
Plant 3	4.1	3.2
Plant 4	4.4	3.3
Plant 5	4.0	3.1
Mean	4.0	3.5

### 3.5. Performance of rambutan varieties on stems diameter and perimeter

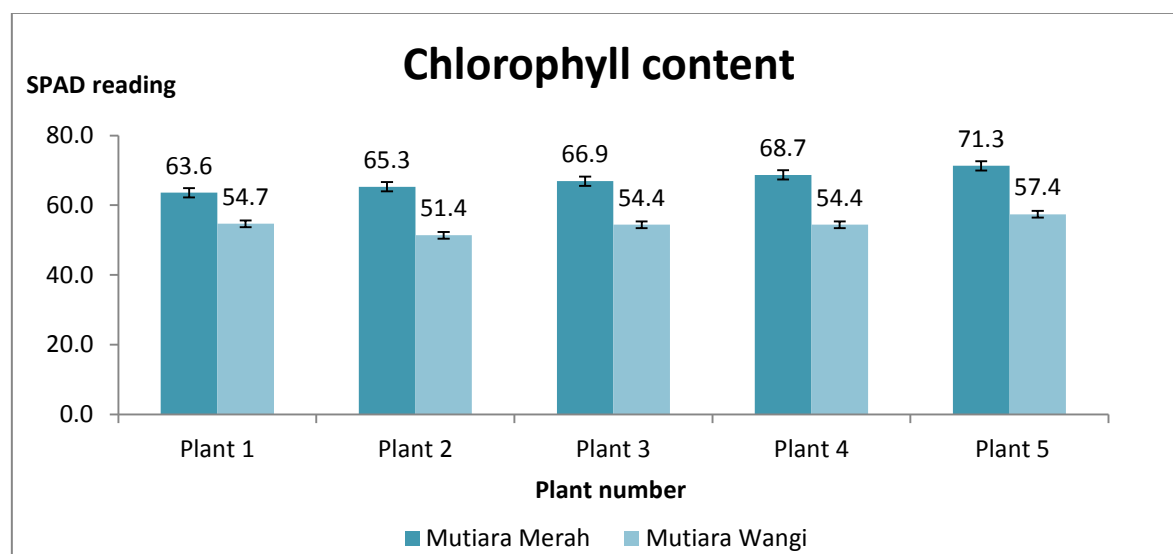
Varieties have a substantial impact on stem diameter. Nonetheless, as indicated in Table 5, *Mutiara Merah* had the highest significant reading with an average of 8.4 cm, while *Mutiara Wangi* had the lowest with an average of 8.2 cm. The stem perimeter follows a similar trend. *Mutiara Merah* had the greatest significant reading with an average of 27.8 cm, while *Mutiara Wangi* had the lowest at 27.6 cm. The diversity of rambutans can be seen from the plant's structure and the characteristics of the fruit (Putri et al., 2022).

**Table 5.** Mean value of stem diameter and perimeter of *Mutiara Merah* and *Mutiara Wangi* cultivated on sandy tin-tailing soil

Source of variance	<i>Mutiara Merah</i>		<i>Mutiara Wangi</i>	
	Stem diameter (cm)	Stem perimeter (cm)	Stem diameter (cm)	Stem perimeter (cm)
Plant 1	7.5	25.0	7.6	24.5
Plant 2	8.9	27.5	9.5	30.5
Plant 3	8.2	27.0	8.0	27.0
Plant 4	9.5	32.0	8.1	27.0
Plant 5	7.7	27.5	8.0	29.0
Mean	8.4	27.8	8.2	27.6

### 3.6. Evaluation of rambutan varieties on Chlorophyll content

The amount of chlorophyll in the rambutan leaves changed depending on the treatment (Figure 1). Plant 5 in the *Mutiara Merah* variety had the greatest chlorophyll content with a 71.3 (SPAD Reading), whereas plant 3 in the *Mutiara Wangi* variety had the lowest with 51.4 compared to others. Understanding tree phenology is critical for interpreting leaf nutrient status and its relevance to tree production, especially when attempts are made to correlate yield and tree nutritional status. Rambutan is a terminal blooming tree where temperature and environment influence flowering, following fruit sets, and so production (Diczbalis, 2002). Rambutan is susceptible to waterlogging, and the soil should be rich in Zinc and Iron; otherwise, leaf yellowing due to nutrient insufficiency is typical (Karunakaran et al., 2016). Despite this difference, a substantial effect was demonstrated owing to the red pigment in the leaf, which inhibited chlorophyll accumulation in leaves. The chlorophyll content of rambutans plants grown in sandy soil differed substantially between treatments.



**Figure 1.** Chlorophyll content of *Mutiara Merah* and *Mutiara Wangi* cultivated on sandy tin-tailing soil

#### 4. Conclusion & Future Recommendations

The findings from all criteria suggested a substantial relationship between rambutan growth varieties. *Mutiara Merah* demonstrated that it can be planted and farmed successfully on sandy tin-tailing soil. *Mutiara Merah's* plant height had the highest significant reading. The canopy width parameter revealed that the same variety contributed to the highest record. Nonetheless, *Mutiara Merah* supplied the most important readings on stem diameter and perimeter. The greatest SPAD Reading was obtained by the chlorophyll content in the leaves of the same species of plant. Despite this difference, there is no substantial influence of red pigment in the leaf on chlorophyll accumulation in leaves. The study also has limitations due to a lack of knowledge on rambutan cultivation in Malaysia's various soil types. There are less comparison studies on the usage of organic and inorganic fertiliser for rambutan performance at different kinds of sources. More field evaluations are required to expand and determine the finding on the association of fertilizer level with different kinds of sources in inducing the development and yield of rambutan planted in marginal soil, particularly in sandy and peat locations.

#### Declarations

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##### Competing Interests Statement

The authors have declared no potential competing interests.

##### Consent for publication

The authors declare that they consented to the publication of this research work.

##### Authors' Contributions

All authors equally contributed to research and paper drafting.

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#### References

- [1] Arévalo-Galarza, M. L., Caballero-Pérez, J. F., Valdovinos-Ponce, G., Cadena-Iñiguez, J., & Avendaño-Arrazate, C. H. (2018). Growth and histological development of the fruit pericarp in rambutan (*Nephelium lappaceum* Linn.). *Acta Horticulturae*, (1194): 165-171. doi: <https://doi.org/10.17660/actahortic.2018.1194.25>.
- [2] Barstow, M. (2017). "*Nephelium lappaceum*". IUCN Red List of Threatened Species. 10.2305/IUCN.UK.2017-3.RLTS.T33266A67808476. Retrieved 19 November 2021. (Accessed on 4th January 2023).

- [3] Brathwaite, C. W. (1987). IICA's contribution to the agricultural sector in Trinidad and Tobago during 1987. Third Regional Workshop on Tropical Fruits (1994). Instituto Interamericano de Cooperación para la Agricultura: 86. 1994. ISSN 0253-4746. <https://repositorio.iica.int/handle/11324/13303>. (Accessed on 4th January 2023).
- [4] Diczbalis, Y. (2002). Rambutan improving yield and quality. A report for the Rural Industries Research and Development Corporation. RIRDC, 9-69. <https://agrifutures.com.au/wp-content/uploads/publications/02-136.pdf>. (Accessed on 3rd January 2023).
- [5] Diczbalis, Y., & Menzel, C. M. (1998). Low temperatures decrease CO<sub>2</sub> assimilation and growth in the tropical rambutan. The Journal of Horticultural Science and Biotechnology, 73(1): 65-71. doi: <https://doi.org/10.1080/14620316.1998.11510945>.
- [6] Karunakaran, G., Tripathi, P. C., Sakthivel, T., Ravishankar, H., Sankar, V., Kumar, R. S., & Mala, B. J. (2016). Rambutan is a potential future fruit. Indian Horticulture, 61(2): 3-5. [https://scholar.google.com/citations?view\\_op=view\\_citation&hl=en&user=o4dTuDwAAAAJ&cstart=20&pagesize=80&citation\\_for\\_view=o4dTuDwAAAAJ:K3LRdlH-MEoC](https://scholar.google.com/citations?view_op=view_citation&hl=en&user=o4dTuDwAAAAJ&cstart=20&pagesize=80&citation_for_view=o4dTuDwAAAAJ:K3LRdlH-MEoC). (Accessed on 3rd January 2023).
- [7] Morton, J. F. (1987). Fruits of Warm Climates. West Lafayette, Indiana, USA: Center for New Crops & Plant Products, Purdue University Department of Horticulture and Landscape Architecture. pp. 262-265. <https://www.cabdirect.org/cabdirect/abstract/19876763104>. (Accessed on 2nd January 2023).
- [8] Putri, I. I. S., Yuniastuti, E., & Parjanto, P. (2022). The rambutan (*Nephelium lappaceum* L.) chromosomes. Biodiversitas Journal of Biological Diversity, 23(4). doi: <https://doi.org/10.13057/biodiv/d230455>.
- [9] Tindall, H. D. (1994). Rambutan Cultivation. FAO Plant Production and Protection Division. Paper 121, Rome, Italia, 163p. [https://scholar.google.com/scholar?hl=en&as\\_sdt=0%2C5&q=Rambutan+cultivation%2C+FAO+Plant+Production+and+Protection&btnG](https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Rambutan+cultivation%2C+FAO+Plant+Production+and+Protection&btnG). (Accessed on 2nd January 2023).
- [10] Vanderlinden, E. J. M., Pohlen, H. A. J., & Janssens, M. J. (2004). Culture and fruit quality of rambutan (*Nephelium lappaceum* L.) in the Soconusco region, Chiapas, Mexico. Fruits, 59(5): 339-350. doi: <https://doi.org/10.1051/fruits:2004032>.
- [11] Windarsih, G. (2022). Characterization of leaf morphology on several rambutan (*Nephelium lappaceum*) cultivars from Serang City, Banten, Indonesia. In Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia, 8(1), doi: <https://doi.org/10.13057/psnmbi/m080103>.